

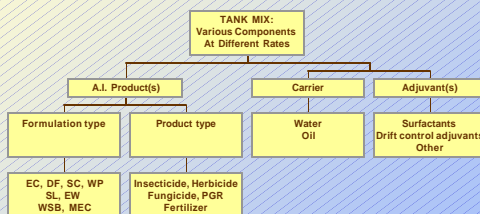
Tank Mix and Adjuvants Summary

- The entire tank mix determines droplet size
- Adjuvants added to improve spray performance
- Droplet size spectra
- Drift potential
- Surfactants
- Drift control adjuvants
- Fertilizers

SDTF Generic Approach

- The entire tank mix, not the a.i. Determines droplet size and drift potential
- Droplet size spectra can be classified using generic categories (ASAE S-572 droplet size categories)

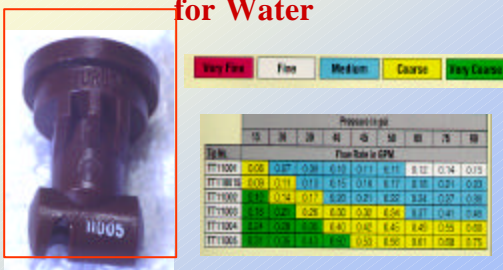
The Entire Tank Mix



Adjuvants as part of the tank mix

- Adjuvants are used with real tank mixes (not water), so tests should not only be based on mixing with water
- Some effects vary with different application conditions (especially nozzle type)

Nozzle Catalogue Spray Quality for Water



DropKick® Spreadsheet

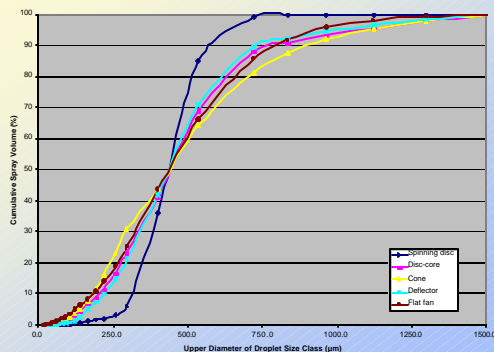
DRAFT		DropKick® II		DRAFT				
Drop size distribution estimator. Select nozzle with the Nozzle list below								
Nozzle Values		Product Values		Nozzle List				
Name of Nozzle	MC001	Name	Water	11005	1.00 gpm/ft			
Spray Quality	Medium	Surface Tension	72.0 dyne/cm	11006	1.00 gpm/ft			
Flow Rate	2.00 gpm	Density	1.00 g/cm³	11007	1.00 gpm/ft			
Relative Spray	0.50	Viscosity	1.00 cP	11008	1.00 gpm/ft			
Orifice dia.	1.0 mm			11009	1.00 gpm/ft			
WEC	30.0 g			11010	1.00 gpm/ft			
Calculate and Record		Extra Coarse		Very Coarse				
Plot Graph of Distribution		Very Coarse		Coarse				
		Medium		Fine				
		Very Fine						
Pressure	Speed	Flow Rate	Angle in degrees					
psi	mph	gpm	0	15	30	45	60	90
20	50	1.41						
25	60	1.41						
30	70	1.41						
35	80	1.41						
40	90	1.41						
45	100	1.41						
50	110	1.41						
55	120	1.41						
60	130	1.41						

DropKick® in AgDRIFT®

How Important is the Tank Mix in Atomization?

- Application parameters (nozzle type, use, pressure, air speed, etc) have major effect on atomization
- Tank mix is generally less important than application parameters, but still significant for many applications

Nozzle Selection



Previous Studies

- SDTF found differences in spray quality from >200 different tank mixes with different formulation, a.i. and pesticide types
- SDTF also looked at some tank mix adjuvants, but only from perspective of surface tension and viscosity effects on atomization and drift
- Subsequent researchers have looked at other effects on spray formation and distribution patterns

Other Research

Unexpected Behavior of Some Spray Fluids

Authors	System and Behavior	Common Property
Miller et al	Oil-based adjuvants. Ground sprays	Increased droplet size
Downer et al	Temperature of sprays of low cloud point surfactant. Ground sprays	Increased droplet size
Dexter	Water-insoluble surfactant Ground sprays	Increased droplet size
Dexter et al	Emulsions of equal DST form larger drops than solutions Aerial spray wind tunnel	Increased droplet size
Dombrowski	Emulsifiable oils	Increased droplet size

Surfactants and Emulsions

- Typically added to increase retention/rainfastness, spreading, sticking, mixing
- Many different products but several major chemistry groups
- Main effect is on surface tension, which can be measured using standard techniques

Polymers

- Used as drift control adjuvants/ deposition aids
- Hundreds of products but only a few chemistries
- Need to be sure of compatibility with nozzle type being used *and* tank mix partners - tests with water may not be representative
- Some polymers break down when pumped giving change in performance over time

Effects of Polymers on Droplet Size Spectrum

- Typically increase $D_{v0.5}$
- Generally increase relative span
- Correlation between droplet size and extensional viscosity (elongational viscosity)

Volume Median Diameter ($D_{v0.5}$) and Relative Span for Various Classes of Fluid Sprayed Through an 8002 Nozzle

Material	Spray Fluid Type	Volume Median Diameter (Microns)	Relative Span
Water	Standard	198	1.4-1.5
Bentonite	Dispersion	194	1.55
Kaolin	Dispersion	201	1.50
Calcium carbonate	Dispersion	202	1.48
Hydrated silica	Dispersion	197	1.48
EC blank formulation	Emulsion aromatic solvent	238	1.15
Sun-It 11	Emulsion oil blend	232	1.12
Methyl canolate	Emulsion seed oil	235	1.16
Silwet L-77	Emulsion silicone surfactant	224	1.20
C13 EO3	Emulsion insoluble surfactant	238	1.12
C13 EO6	Emulsion insoluble surfactant	212	1.17
C13 EO9	Soluble surfactant	132	1.86
C13 EO12	Soluble surfactant	137	1.79
C10 EO6	Soluble surfactant	140	1.84

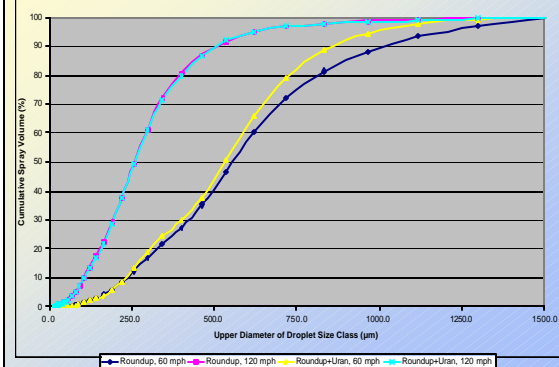
Spray Drift

- Any adjuvant that causes an increase in “fines” ($<150 \mu\text{m}$) may increase drift potential in aerial and many ground rig applications
- Although droplet size is main influence on drift, other factors are also important (e.g. droplet velocities, trajectories, evaporation rates, encapsulation, etc)

Fertilizer Effects

- Some suggestions that fertilizers increase drift potential
- Probably actually increase drift damage rather than drift exposure risk
- Literature reports on increased activity of glyphosate with ammonium sulfate
- SDTF conducted atomization tests showing no effect on droplet size spectra

Figure 1. Atomization of Roundup Through CP0.125 With 30° Deflector, With and Without Uran at 60 and 120 mph Flight Speeds



New SDTF Fact Sheet

- New fact sheet on tank mixes and nozzles
- Explains droplet size classification and SDTF atomization and physical property studies
- Available in hard copy and on www.agdrift.com

Conclusions

- Formulation effects on nozzle performance are important, influencing atomization, retention, efficacy and spray transport/ drift
- Entire tank mix, not a.i. or formulation type, affects drift potential
- Entire droplet size spectrum (especially “fine” end) important, not only VMD
- Surfactants and crop oils have varying effects
- Emulsions may increase droplet size and narrow the spectrum width

Conclusions

- Some polymers broken down by pumping
- Some new nozzle designs may be more sensitive to formulation effects
- Other effects: encapsulation, evaporation retardants, etc
- Ongoing and future work looking at total spray process